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Fuel Rod Cladding Development Program in Palo Verde Unit 3:

Examination of Fuel Rods with Advanced Cladding Materials at End-of-Cycle 9

Westinghouse

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Fuel Rod Cladding Development Program in Palo Verde Unit 3: Examination of Fuel Rods with Advanced Cladding Materials at End-of-Cycle 9

July, 2002

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Approved: ____________________
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Summary

Since the late 1980's ABB CE Nuclear Power, now Westinghouse Electric Company, and APS have cooperated in a development program to demonstrate the performance of advanced fuel rod cladding materials. The objective of the program has been to identify cladding materials that offer improved corrosion resistance and dimensional stability in a high temperature reactor. As part of the program, Lead Fuel Assemblies (LFAs), fabricated with fuel rods that utilize cladding with materials specifications that are outside the ASTM Specification for Zircaloy-4, were introduced in Palo Verde 3 in Cycle 7. Two Lead Fuel Assemblies (LFAs) were fabricated as part of Batch J and loaded in Palo Verde 3 at the beginning of Cycle 7. All 236 rods in each LFA were fabricated using the same advanced cladding material, either Alloy A (Assembly P3J408) or Anikuloy (Assembly P3J407). The LFAs operated in Cycles 7 and 8 and were examined during the refueling outages after both cycles of irradiation. The Alloy A assembly was reinserted for continued operation in Cycle 9. The Anikuloy assembly was discharged at the end of cycle 8.

This report documents the examinations that were performed on the Alloy A LFA Assembly (P3J408) following PV-3 Cycle 9. The results of the examinations that were performed on the LFAs following PV-3 Cycle 7and 8 are reported in an earlier test reports.

The primary objectives of the examinations were to characterize and evaluate the overall performance of the test rods with Alloy A cladding after 3 cycles of operation and confirm suitability for continued irradiation of the rods in Cycle 10. The successful operation of the assembly during Cycle 9 would be the prerequisite for reinsertion in Cycle 10. The evaluation criteria were established prior to the Outage (Reference 9) and defined as acceptable visual appearance, oxide thickness limits below established permissible limits and adequate shoulder gap margin.

Examination of the Batch J LFA with Alloy A cladding after three cycles of operation and rod average burnups up to [ ] MWd/kgU have shown that the assembly and rods are in excellent condition. All oxide thickness measurements were below the established permissible limits for the rods measured and adequate shoulder gap margin will exist through the predicted end of life for this assembly. No apparent anomalies were observed that would indicate unacceptable performance.

The inspection results continue to indicate that Alloy A cladding offers improvements of at least [ ]% in corrosion resistance relative to OPTIN cladding. The maximum circumferentially averaged oxide thickness for the rods with Alloy A cladding ranged from [ ] to [ ] μm after three cycles of operation. Assembly P3J408 was inserted in Cycle 10 for its fourth cycle of operation.

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1.0 Introduction

The results of fuel examinations that were conducted during the EOC-9 refueling outage for Palo Verde 3 are documented in this report. The examinations performed during this outage are part of an irradiation program that is being conducted by Westinghouse Electric Company and APS. The objective of the program is to assess the potential for improved corrosion resistance of advanced cladding alloys.

The program consists of irradiation of two Lead Fuel Assemblies (LFAs). The LFA program was initiated at BOC-7 in Unit 3. The LFA program utilizes two Batch J assemblies (P3J407 and P3J408) as carriers of rods with composition and fabrication differences. The LFAs were fabricated using only two advanced cladding alloys and all of the 236 rods in each assembly utilize that same alloy. Assembly P3J407 contains rods fabricated with Anikuloy (also called Alloy F) cladding. Assembly P3J408 contains rods fabricated with Alloy A cladding. A description of these alloys is in Reference 1. PV-3 Cycle 7 was the 1st irradiation cycle for LFAs P3J407 and P3J408. Examinations were conducted on both LFAs and individual rods from each assembly during the EOC-7 and EOC-8 refueling outages. The results of the examination from the EOC-7 outage are reported in Reference 2. The results of the examination from the EOC-8 outage are reported in Reference 3. The Anikuloy LFA was discharged at the end of Cycle 8. The results of the examination from the EOC-9 outage are reported herein for the Alloy A Assembly.

1.1 Background and Operating Histories

The Batch J LFAs with Anikuloy and Alloy A cladding (P3J407 and P3J408, respectively) were fresh fuel assemblies at the beginning of Cycle 7. Individual rods in the LFAs and the assemblies were characterized prior to irradiation. Characterization information is documented in Reference 4. The LFAs operated in symmetric core locations in Cycles 7 and 8. Figure 1.1 shows their respective locations in these cycles. The assembly average and peak rod burnup for both LFAs at EOC-7 were [ ] and [ ] MWd/kgU (Reference 2), respectively, and [ ] and [ ] MWd/kgU, respectively, at EOC-8 (Reference 5). The assembly average and peak rod burnup for the Alloy A assembly at EOC-9 was [ ] and [ ] MWd/kgU, respectively (Reference 6).

Individual fuel rods from the Alloy A assembly (P3J408) were examined following Cycle 9. The examinations performed on the assembly included assembly visual inspection with the underwater periscope, shoulder gap measurements of peripheral rods and guide tube length measurements. The examination conducted on the individual rods from P3J408 only characterized corrosion. The individual rods examined from P3J408, and their respective rod average burnup and fluence at EOC-9, are listed in Part I of Table 1.2. Part II of the table identifies the specific inspections performed on each of the examined rods.

The rod average burnup and fluence values for the examined rods at EOC-9 that are listed in Part I of Table 1.2 were extracted from Figures 3.1.5-9 through 3.1.5-11 in Reference 6. The EOC-9 fluence values from Reference 6 were converted from E>1MeV to E>0.821MeV by dividing by 0.89.

1.2 Reactor Operations

The reactor coolant temperatures and pertinent parameters for the cycles in which the LFAs were irradiated are listed in Table 1.1. The data were obtained by email communication from APS, Nuclear Fuel Management and are presented for information only.

Table 1.1

Reactor Coolant Temperature and Other Pertinent Parameters for PV-3 During Reactor Cycles 7, 8 and 9

Reactor Cycle	Core Avg. Power, kW/ft	Cycle EFPD's	Reactor Inlet Temperature, °F	Reactor Outlet Temperature, °F
7				
8				
9				

Table 1.2

Part I

Batch J Rods with Alloy A Cladding Examined Following Cycle 9

Rod Serial Number	Cladding Type	Location in Assembly P3J408	EOC-9 Rod Avg. Burnup, MWd/kgU	EOC-9 Fluence(1) x 10^{-21}, n/cm^2
0500807	Alloy A	L16		
0500815	Alloy A	P14		
0500828	Alloy A	D16		
0500858	Alloy A	N16		
0500901	Alloy A	A9		
0500902	Alloy A	P8		
0500903	Alloy A	I16		
0501304	Alloy A	D14		
0501357	Alloy A	M14		

(1) E>0.821 MeV

Part II

Examinations Performed on Batch J Rods With Alloy A Cladding After Cycle 9

Rod Serial Number	EOC-9 Exams		
	Eddy Current Inspection	Visual Inspection	Oxide Meas.
0500807	X	X	X
0500815	X	X	X
0500828	X	X	X
0500858	X	X	X
0500901	X	X	X
0500902	X	X	X
0500903	X	X	X
0501304	X	X	X
0501357	X	X	X

Figure 1.1

PV-3 Core Schematic Identifying LFA Locations in Cycles 7, 8 and 9

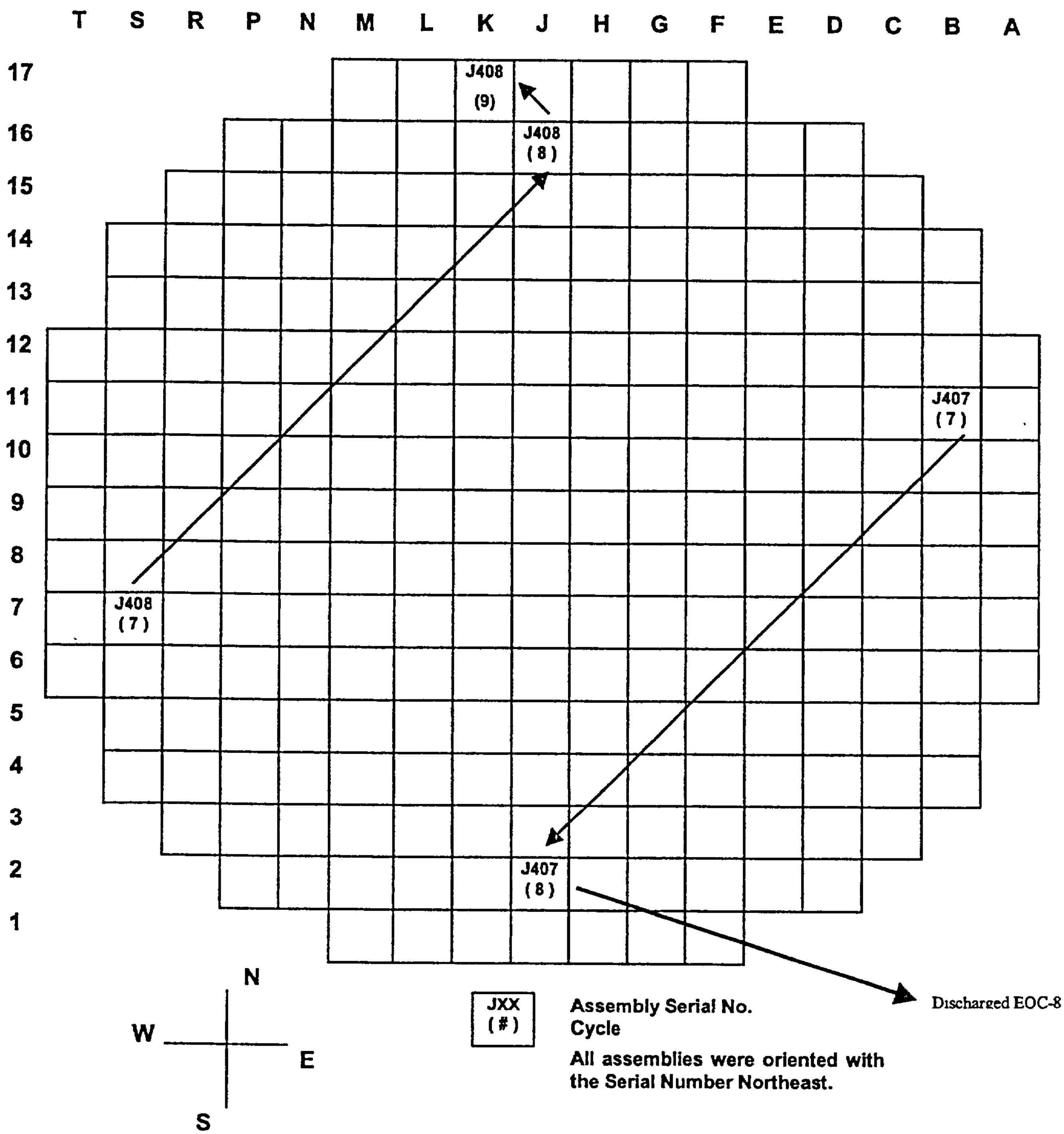
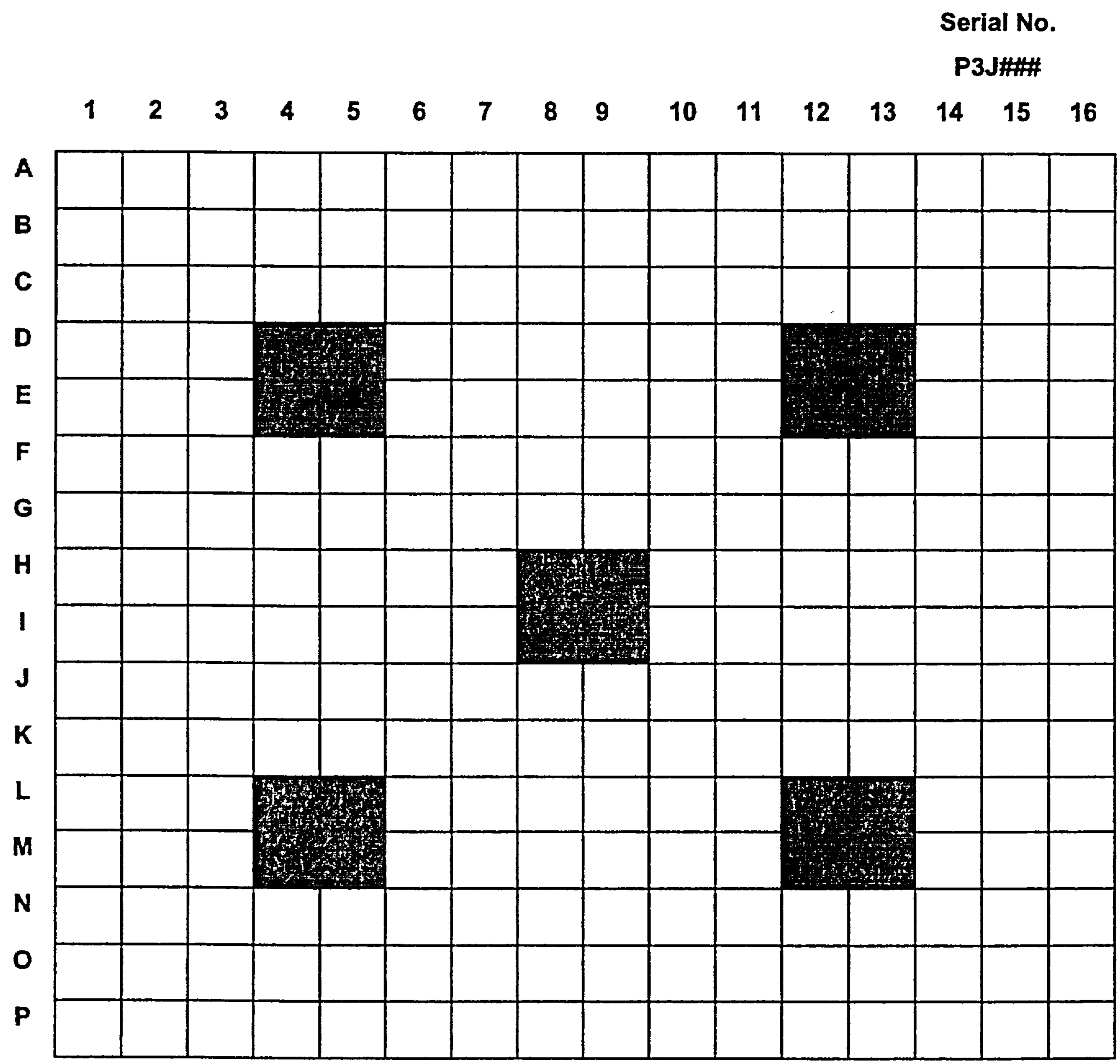


Figure 1.2

Schematic of PV-3 Assembly Showing the Designation System for Rod Locations



2.0 Assembly Examinations

2.1 Visual Examinations at EOC-9

A visual inspection of Assembly P3J408 was performed during the EOC-9 outage. The visual inspection was conducted using the underwater periscope. Observations of interest and anomalies were recorded using a 35mm camera.

The visual inspection of Assembly P3J408 after three cycles of irradiation found the assembly to be in good condition. No anomalies were observed on any of the peripheral rods or spacer grids. The shoulder gaps of the peripheral rod were large and relatively uniform.

Figures 2.1 through 2.4 are photographs of the upper end of the rods showing the remaining shoulder gap for Assembly P3J408. Figure 2.5 is a photograph of Span 8 of the 0° face of Assembly P3J408 showing the crud patterns on the surface of the Alloy A rods. One of the center rods is brighter in appearance than the others because crud was removed from its surface when it was examined at EOC-8. Figure 2.6 is a high magnification photograph of the center rods of Span 8 of the 0° face of Assembly P3J408. It shows the uniform appearance of the crud on the Alloy A rods. One rod is cleaner in appearance due to its removal for examination at EOC-8. The rod appears lighter in Figure 2.6 due to the differences in light reflectivity between high and low magnification. Figure 2.7 is a photograph of Span 8 of the 90° face of Assembly P3J408 showing the appearance of the crud and the formation of Elliptical Surface Anomalies (ESA's) on the Alloy A rods. This crud pattern and these ESA's were present at the EOC-7 as noted in Reference 2.

2.2 Shoulder Gap Measurements

Shoulder gap measurements were performed on each peripheral rod in Assembly P3J408 following Cycle 9. The measurements were made using the underwater periscope in accordance with Reference 7. Micrometer readings that correspond with the top of the fuel rods and bottom of the upper end fitting flow plate were recorded on data sheets. The difference between these two readings times the magnification factor is the shoulder gap. The magnification factor was determined by making similar measurements on a standard with known gaps. The calculated shoulder gaps, the periscope measurements on the standard, the calculation of the magnification factor, and the periscope measurements for assembly P3J408 is included in Appendix A.

The shoulder gaps, calculated gap closure, and neutron fluence of each of the peripheral rods in Assembly P3J408 after Cycle 9 is presented in Table 2.1. One of the criteria for the LFA to be inserted into Cycle 10 was that the minimum shoulder gap for all peripheral rods at EOC-9 be ≥ 1.2 inch. As evidenced by the data, all peripheral rods met this criterion. Figure 2.8 presents the shoulder gap closures calculated for the measured rods after Cycle 9, as well as the data from after Cycles 7 and 8 (Reference 2 and Reference 3), plotted as a function of rod average fluence.

As noted from the figure, rods with [

].

2.3 Guide Tube Length Measurements

The overall lengths of the guide tubes in Assembly P3J408 were measured following Cycle 9. Measurements were made in accordance with Reference 14. Guide tube length data is presented in Appendix C. The average growth of Assembly P3J408 guide tubes after 3 cycles of irradiation and a average guide tube fluence of [ ]. The average guide tube growth after one cycle of operation was [ ] with an average fluence of [ ]. Figure 2.9 presents the guide tube growth data generated for Assembly P3J408 at EOC-7 and EOC-9. The growth data are plotted as a function of average guide tube fluence. Also shown in Figure 2.9 are guide tube growth data for PV1 and PV3 assemblies that were previously measured. Those data are from Reference 2, Figure 2.6. In addition to the measurement data, Figure 2.9 shows the best estimate and lower 95% tolerance limit for the SIGREEP predictions for growth of cold worked and stress-relief annealed Palo Verde guide tubes (Reference 15, page 9). Guide tube length measurements were not made following the second cycle of operation. As expected, guide tube growth for the assembly is consistent with other Palo Verde assemblies and the SIGREEP predictions.

Table 2.1

Shoulder Gap Measurements for Assembly P3J408 at EOC-9

* Rods numbered 1 to 16, left to right across assembly face.

** Fluence x 10^{-21}, n/cm^2

Figure 2.1

Shoulder Gaps for the 0° Face of Assembly P3J408

Figure 2.2

Shoulder Gaps for the 90° Face of Assembly P3J408

Figure 2.3

Shoulder Gaps for the 180° Face of Assembly P3J408

Figure 2.4

Shoulder Gaps for the 270° Face of Assembly P3J408

Figure 2.5

Appearance of Alloy A Rod Surfaces at Span 8, 0° Face of Assembly P3J408 at EOC-9

Figure 2.6

Close Up View of Alloy A Rod Surfaces at Span 8, 0° Face of Assembly P3J408 at EOC-9

Figure 2.7

Appearance of Alloy A Rod Surfaces at Span 8, 90° Face of Assembly P3J408 at EOC-9

Figure 2.8

Shoulder Gap Closure for Assembly P3J408

Shoulder Gap Closure, Inches

Rod Average Fluence x 10^21, n/cm^E>0.821 MeV

Figure 2.9

Palo Verde Guide Tube Growth

Guide Tube Growth, Inches

Average Fluence x 10^{-21}, n/cm^2, E>0.821 MeV

3.0 Single Rod Examinations and Data Evaluations

3.1 Fuel Rod Eddy Current Testing

EOC-9 Inspections

The nine fuel rods removed from Assembly P3J408 during the EOC-9 examination program were eddy current tested to evaluate cladding overall integrity. Eddy current testing (ECT) was performed, per Reference 8, [ ]. Vector analysis was used to obtain phase angle and signal amplitude for comparison of indications on the rods to calibration standards. The evaluations of ECT indications on each rod are presented in Appendix B.

There were no detectable defects noted by ECT on the three cycle rods with Alloy A cladding.

3.2 Visual Examinations

Visual Inspection of Rods from P3J408 at EOC-9

Visual inspections were performed, using an underwater TV system, of the 9 rods removed from Assembly P3J408. Video recordings were made of the rods from P3J408 as they were examined.

All of the rods examined from the LFA were in excellent condition. No anomalies were observed. The coloration of the oxide on the rods was typical for three cycles of exposure. Figure 3.1 is an example of the grid contact marks seen on these rods. The contact marks shown are from the top of Rod D16 where they are more easily distinguished from the rest of the rod. This same rod was viewed during the EOC-8 examination. There does not appear to be any significant change in the size or depth of these indications. Figure 3.2 is a photo of the remnant ESAs in Span 8 of Rod D16. Again, this is the same area that was viewed and reported on after the EOC-8 examination. These ESAs coincide with the area of highest oxide accumulations and may be contributing to the overall oxide thickness at this elevation. The profile of the ESAs is not as well defined in this photo compared to the EOC-8 photo due to an accumulation of crud during cycle 9 and lighting conditions. Figure 3.3 is a photo of rod D16 showing the vertical pattern created on the rod surface due to contact between the rod and the centering device of the rod handling tool [

].

3.3 Rod Length Measurements and Fuel Rod Growth

Rod length measurements were not performed during the EOC-9 examination program.

3.4 Oxide Thickness Measurements and Corrosion Performance

Oxide thickness measurements were performed during the EOC-9 examination program. Part II of Table 1.2 identifies the rods measured during the EOC-9 program. A nondestructive eddy current technique was used to measure the thickness of the waterside corrosion layer on the outer surface of the fuel rods. The measurements were performed, per the procedure of Reference 11, with the rods removed from the assembly. Four continuous axial traces of oxide thickness were made for each of the measured fuel rods at azimuthal orientations that were 90° apart. The orientations correspond with the orientation of the rod as it resided in the assembly (e.g., 0° side of the rod faced the 0° face of the assembly, etc.)

The measurement data generated for each rod by the four axial scans were combined to form a composite axial and circumferential map of oxide thickness. Appendix D presents the individual composites for the rods measured after Cycle 9. A maximum, circumferentially averaged oxide thickness was calculated for each rod. Table 3.1 lists the maximum oxide thickness data and other pertinent information for each rod measured after Cycle 9. The maximum oxide thicknesses listed in the table are defined as the thickest oxide layer for any one-inch interval of cladding. The maximum is calculated [

].

Maximum, circumferentially averaged oxide thicknesses for the measured LFA rods with Alloy A cladding ranged from [ ] to [ ] μm at EOC-9 after 3 cycles of operation. Oxide thickness predictions were made to determine the maximum thickness permissible at EOC-9 to permit continued operation in Cycle 10 (Reference 9). The preliminary W-CE high duty corrosion model was used to calculate the maximum oxide thickness on the outer surface of the fuel rod cladding for selected rods. [

].

The limits were calculated for each rod on the basis that the predicted oxide thicknesses were not to exceed 120 microns at EOC-10 (consistent with 100 microns best estimate). These are conservative limits, as the data on Alloy A shows a corrosion rate roughly [ ]. All of the rods measured were below the limits established for reinsertion into Cycle 10. Figure 3.4 presents the maximum oxide thickness data from Table 3.1 plotted as a function of rod average burnup. Also plotted are data for the Batch F LTRs with Alloy A cladding that were measured after each of the four cycles that these rods were irradiated (Cycles 4, 5 (Reference 12), Cycles 6, 7 (Reference 2, Figure 3.8). In addition, the best estimate equation for PV-1 Batch D rods irradiated for 5 cycles (LSN Regression, pg. 36 of Reference 13) is plotted to provide perspective. The LFA Alloy A rod data is consistent with the oxide measurements for the LTR Alloy A rods.

The linear regression for rods with Alloy A cladding that is shown in Figure 3.4 was generated using the measurement data for the Alloy A LTRs and rods from P3J408. Based on a comparison of the best estimate predictions for the Alloy A clad rods and the PV-1 D rods, the Alloy A cladding [ ].

Table 3.1

Maximum Oxide Thickness Data for Rods Measured from Assembly P3J408 after Cycle 9

Rod Serial No.	Location in Assembly	Cladding Type	Rod Avg. Burnup, MWd/kgU	Measurement Azimuthal Orientation(1) 0	90	180	270	Maximum Circumferential Average, Microns	Elevation(2), inches
500807	L16	Alloy A							
500815	P14	"							
500828	D16	"							
500858	N16	"							
500901	A9	"							
500902	P8	"							
500903	I16	"							
501304	D14	"							
501357	M14	"							

(1) Azimuthal orientations of rod are identical to assembly orientations: 0° orientation aligned with 0° face of Assembly.

(2) Inches from bottom of rod.

Figure 3.1

Grid Contact Marks at the top of Rod D16, P3J408

Figure 3.2

Remnant ESAs in Span 8 of Rod D16, P3J408

Figure 3.3

Vertical Pattern Created by Crud Removal During Handling

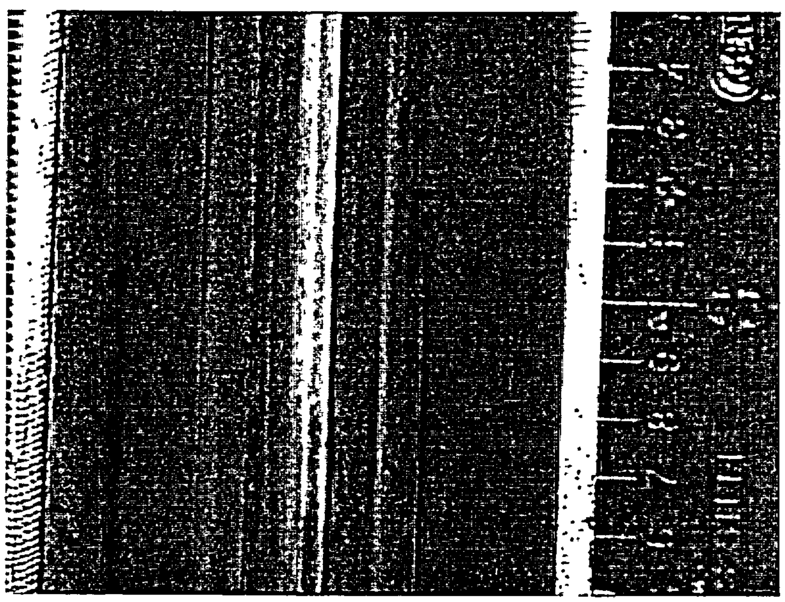


Figure 3.4

Comparison of OPTIN™ and Alloy A Cladding Corrosion

Maximum Oxide Thickness, µm

Rod Average Burnup, MWd/kgU

4.0 Assembly Reconstitution

Following the examination of individual rods after Cycle 9, all of the test rods were reinserted into their original locations. Care was taken to reinsert each rod with azimuthal orientations the same as prior to removal.

5.0 Conclusions

Examination of the Batch J LFA with Alloy A cladding after three cycles of operation and rod average burnups up to [ ] MWd/kgU have shown that the rods are in excellent condition. No apparent anomalies were observed that would indicate unacceptable performance in the LFA.

The inspection results indicate that the performance of Alloy A cladding in the LFA after three cycles of operation are [

]. Assembly P3J408 was inserted in Cycle 10 for its fourth cycle of operation. Measurements performed after Cycle 9 show that [

].

6.0 References

1. CEN-429-P, Rev. 00-P, "Safety Analysis Report for Use of Advanced Zirconium Based Cladding Materials in PVNGS Unit 3 Lead Fuel Assemblies," August 1996.

2. CE NPSD-828-P, Rev. 00, "Fuel Rod Cladding Development Program in Palo Verde Unit 3: Examination of Fuel Rods with Advanced Cladding Materials at End-of-Cycles 6 and 7," January 2000.

3. CE NPSD-873-P, Rev. 00, "Fuel Rod Cladding Development Program in Palo Verde Unit 3: Examination of Fuel Rods with Advanced Cladding Materials at End-of-Cycle 8," July 2000.

4. A. M. Garde, "Fabrication & Characterization of PV3J LFAs, " AMG-97-001, February 26, 1997.

5. A-PV-FE-0146, Rev. 00, "Calculation of Pin by Pin Data for Quarter Core Boxes 10 & 65, plus Core Integrated RPD Data for Palo Verde Unit 3 Cycle 8," R. E. Hurt, March 31, 2000.

6. A-PV3-FE-0148, Rev. 001, "Redepletion of Palo Verde Unit 3 Cycles 6, 7, 8, 9, and 10 for Evaluation of Test Rods," R. E. Hurt, 5/23/02.

7. APS Procedure, "Fuel Rod Shoulder Gap Measurements," 78CP-9FH13, Rev. 01.

8. APS Procedure, "Fuel Rod Eddy Current Defect Examination", 78CP-9FH07, Rev. 01, March 15, 1994.

9. M-PV3-FMDE-2001-006, Rev. 00, "Proposed Workplan for Fuel Examinations to be Conducted During the Palo Verde 3 EOC-9 Refueling Outage," R. N. Bosco October 5, 2001.

10. Not Used

11. APS Procedure, "Single Fuel Rod Oxide Thickness Measurements", 78CP-9FH09, Rev. 00, February 1992.

12. G.P. Smith, Jr. "Fuel Rod Cladding Development Program in Palo Verde Unit 3: Fuel Examinations at EOC-4 and EOC-5," Attachment B to CMD-96-001, January 31, 1996.

13. A-PV3-FE-0139, Rev. 00, "Palo Verde 3 Cycle 7 Lead Fuel Rods Corrosion Analysis," M.A. Krammen, February 10, 1997.

14. APS Procedure, "Fuel Assembly Guide Tube Length Measurements", 78CP-9FH14, Rev. 0.

15. Design Calculation # 3400-610-014, Rev. 00, "Generic Dimensional Change Analysis for 16x16 Fuel with SRA Guide Tubes", R. P. Broders, May 10, 1989.

Appendix A

Fuel Rod Shoulder Gap Measurements

Appendix B

Fuel Rod Eddy Current Test Report

Fuel Rod Eddy Current Test Report for EOC-9 Inspections

Appendix C

Guide Tube Length Measurement Data

Guide Tube Length Measurement Data for EOC-9

Appendix D

Fuel Rod Oxide Thickness Composites

Figure D-1: Composite Trace for Fuel Rod 501357 from Assembly P3J408 Location M14

Figure D-2: Composite Trace for Fuel Rod 501304 from Assembly P3J408 Location D14

Figure D-3: Composite Trace for Fuel Rod 500828 from Assembly P3J408 Location D16

Figure D-4: Composite Trace for Fuel Rod 500858 from Assembly P3J408 Location N16

Figure D-5: Composite Trace for Fuel Rod 500901 from Assembly P3J408 Location A9

Figure D-6: Composite Trace for Fuel Rod 500902 from Assembly P3J408 Location P8

Figure D-7: Composite Trace for Fuel Rod 500903 from Assembly P3J408
Location I16

Figure D-8: Composite Trace for Fuel Rod 500807 from Assembly P3J408
Location L16

Figure D-9: Composite Trace for Fuel Rod 500815 from Assembly P3J408 Location P14

Enclosure 3

Westinghouse Electric Company LLC Proprietary Affidavit for Lead Fuel Assembly – Unit 3, Cycle 9 Inspection Results

Proprietary Affidavit

I, Ian. C Rickard, depose and say that I am the Licensing Project Manager, Windsor Nuclear Licensing, of Westinghouse Electric Company LLC (WEC), duly authorized to make this affidavit, and have reviewed or caused to have reviewed the information which is identified as proprietary and described below

I am submitting this affidavit in conformance with the provisions of 10 CFR 2.790 of the Commission's regulations for withholding this information. I have personal knowledge of the criteria and procedures utilized by WEC in designating information as a trade secret, privileged, or as confidential commercial or financial information.

The information for which proprietary treatment is sought, and which documents have been appropriately designated as proprietary, is contained in the following:

WCAP-15848-P, Rev. 0, "Fuel Rod Cladding Development Program in Palo Verde Unit 3: Examination of Fuel Rods with Advanced Cladding Materials at End-of-Cycle 9", July, 2002

Pursuant to the provisions of Section 2.790(b)(4) of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information included in the documents listed above should be withheld from public disclosure.

i. The information sought to be withheld from public disclosure is owned and has been held in confidence by WEC. It consists of information concerning examination data supporting the development of advanced fuel rod cladding materials including specific examination methods developed by WEC, operational parameters, inspection data, data correlations and photographs

ii. The information consists of test data or other similar data for the design, development and concerning advanced fuel rod cladding materials, specific examination methods developed by WEC, operational parameters, inspection data, data correlations and photographs, the application of which results in substantial competitive advantage to WEC.

iii. The information is of a type customarily held in confidence by WEC and not customarily disclosed to the public

iv. The information is being transmitted to the Commission in confidence under the provisions of 10 CFR 2.790 with the understanding that it is to be received in confidence by the Commission.

v. The information, to the best of my knowledge and belief, is not available in public sources, and any disclosure to third parties has been made pursuant to regulatory provisions or proprietary agreements that provide for maintenance of the information in confidence

vi. Public disclosure of the information is likely to cause substantial harm to the competitive position of WEC because:

  a A similar product is manufactured and sold by major competitors of WEC.

  b. WEC invested substantial funds and engineering resources in the development of this information A competitor would have to undergo similar expense in generating equivalent information.

  c. The information consists of examination data supporting the development of advanced fuel rod cladding materials including specific examination methods developed by WEC, operational parameters, inspection data, data correlations and photographs, the application of which provides a competitive economic advantage. The availability of such information to competitors would enable them to design their product to better compete with WEC, take marketing or other actions to improve their product's position or impair the position of WEC's product, and avoid developing similar technical analysis in support of their processes, methods or apparatus.

  d. In pricing WEC 's products and services, significant research, development, engineering, analytical, manufacturing, licensing, quality assurance and other costs and expenses must be included. The ability of WEC's competitors to utilize such information without similar expenditure of resources may enable them to sell at prices reflecting significantly lower costs

  e. Use of the information by competitors in the international marketplace would increase their ability to market a competing product, reducing the costs associated with their technology development.

I C Rickard

Ian. C. Rickard
Licensing Project Manager
Westinghouse Electric Company LLC

Sworn to before me this **29th** day of **August, 2002**

Linda A. Scata

Notary Public
My commission expires: May 31, 2003